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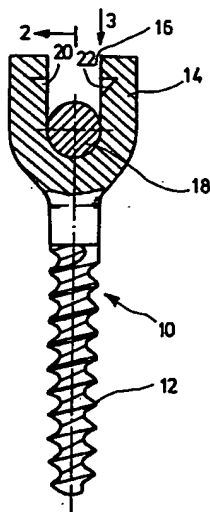
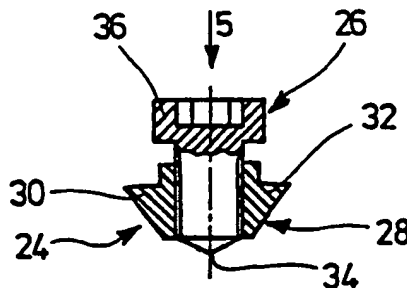
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(54) **An apparatus for correcting a spinal column having a damaged vertebrae.**

(57) An apparatus for correcting a spinal column having damaged vertebrae comprising a fastener (10) to be secured to adjacent vertebrae, said fastener including a shaft portion (12), preferably a pedicle screw, which fastener (10) has a receiving slot (16) to receive a distracting or compressing bar (18) at its free end, and a first locking element (26) including a

threaded portion which may be secured onto the bar (18) disposed in that receiving slot (16), wherein a second locking element (28) is provided which can be fixed to the free end of said fastener (10) and which threadably receives said first locking element (26).

**FIG.1****FIG.4**

102(b)  
1-5

**EP 0 672 388 A1**

The present invention relates to an apparatus for correcting a spinal column having damaged vertebrae according to the preamble of claim 1.

Supporting means for the human spinal column including co-acting lamina hooks and pedicle screws are conventional. British patent 2 131 300 discloses a compressing apparatus, while U.S. patent 4,382,483 relates to a distracting apparatus. The bar bridges a number of vertebrae and does not allow to properly affect the vertebrae lying between the lamina hooks.

WO 91/01691 discloses an apparatus for lacing vertebrae of a spinal column in which pedicle screws having slotted heads are used into which a bar is inserted. The legs of the slotted screw heads comprise an outer threaded portion, onto which a nut is screwed which abuts against the bar to fix it in position. EP 0 443 892 discloses a similar apparatus in which the slotted head of the pedicle screw includes an internal threaded portion receiving a solid screw which is brought into engagement with a fluted or, respectively, roughened bar to again fix the relative position of the bar and the individual pedicle screws. A ring surrounding the head of the pedicle screw prevents the legs of the screw head from spacing apart when the bar is fixed, otherwise the threaded engagement between the fixing screw and the pedicle screw head would be lost. A similar apparatus is shown in WO 90/09156.

Still further, G 92 02 745 discloses an apparatus of the type referred to in which the pedicle screw is formed as a bipartite member, wherein the screw shaft includes a spherical end which is received in a ball-shaped recess which forms a receiving slot for the distracting or compressing bar. A fixing screw is screwed into an internal thread portion of the ball-shaped recess to urge the distracting bar onto the ball. G 93 02 700 further teaches to provide a similar ball-shaped recess with an internal threaded portion onto which a head nut is screwed which includes a central pin which can be brought into engagement with the distracting or compressing bar for fixing. The support between the ball-shaped recess and the hook or the pedicle screw which is pivotal before the final fixing is completed results in the advantage that the fastener at one hand and the ball-shaped recess at the other hand may be angularly oriented with respect to each other. Accordingly, the bar has to be bent to a less extent which is true for a sagittal and lateral orientation.

As far as the devices just referred to provide for screwing the primary locking element shaped as a cap nut or as a screw is screwed on the locking element, the distracting or compressing bar is initially fixed and a distraction or compression may be performed in a manner known per se.

Subsequently, the primary locking element is completely locked to produce a rigid connection between the locking element and the bar. The known devices require primary locking elements which must be screwed onto the locking element for a sufficient length in order to obtain a rigid initial fixing of the bar. The range of laterally moving the bar is thus not particularly large.

It is thus the object of the present invention to provide an apparatus for correcting a spinal column having damaged vertebrae in which after inserting a distracting or compressing bar, this bar may be initially secured so that it has a sufficient play within the locking element, but can be rigidly secured thereafter.

The object referred to is solved by the features of the invention according to claim 1.

According to the invention, the apparatus provides for a pair of locking elements, located at the free end of the fastener, wherein the primary locking element cooperates with a threaded portion of second locking element to rigidly secure the bar which second locking element is fixed to the fastener in an appropriate manner.

A variety of different embodiments is conceivable to fix the second locking element to the free end of the fastener. According to the invention, an embodiment is provided according to which the second locking element is plate-like formed to be inserted into opposite grooves which are provided in the wall of the receiving slot. The grooves may be closed at one end to prevent the second element from falling out. The grooves may be wedge-shaped either alternatively or in addition to coact with the second plate-shaped locking element in a clamping relation. Inserting the plate-shaped second locking element is relatively simple which facilitates using the apparatus according to the invention for the surgeon.

According to a further alternative design the threaded portion of the second locking element is formed in the front face of a cap nut which may be screwed onto the outer thread portion of the anchoring element provided in the vicinity of the receiving slot.

The invention is hereinafter described in more detail with reference to the drawings which show:

- Fig. 1 is a sectional view of a pedicle screw including a distracting or compressing bar;
- Fig. 2 is a sectional view of Fig. 1 along line 2-2;
- Fig. 3 is an end view of the pedicle screw of Fig. 1;
- Fig. 4 is a sectional view of the locking elements for a pedicle screw according to Figs. 1 and 2;
- Fig. 5 is a top view of the elements shown in

- Fig. 4 in the direction of arrow 5;  
 Fig. 6 is a sectional view of a further embodiment of a pedicle screw including a compressing or distracting bar;  
 Fig. 7 is a combination of a pair of locking elements for the pedicle screw of Fig. 6.

The pedicle screw 10 comprises a screw shaft 12 and a head 14 which outer periphery is substantially cylindrical and includes a central receiving slot 16 which is open towards the top end. The bottom of the slot has a spherical cross-section to closely fit a distracting or compressing bar 18. Above the bar 18 the side walls of the slot 16 are formed with grooves 20, 22 having a triangular cross-section. Fig. 1 shows that the upper side of the triangle is perpendicularly oriented with respect to the longitudinal axis of the slot. Fig. 2 shows that the grooves 20, 22 are closed at one end and include a slope.

Figs. 4 and 5 show a combination 24 of a first locking element 26 and a second locking element 28. The second locking element 28 includes a pair of faces 30, 32 being triangular in cross-section which are shaped to fit into the grooves 20, 22. However, there may be provided a slight clamping action in order to fix the plate 28 within the grooves 20, 22. The plate 28 has a central threaded portion for receiving the second locking element 26 which is defined by a fixing screw having a tip 34 at the end of the shaft and an opposite head which is provided with an external as well as an internal hexagonal configuration 38. When the combination 24 will be inserted into the grooves 20, 22 after the bar 18 has been inserted in the slot 16, the bar has sufficient play, but is secured from being moved out of the slot 16. After completing the distraction or compression, the screw 26 is actuated until the tip 34 firmly contacts the bar 18 to complete locking the bar to the head of the pedicle screw 10.

As mentioned before, the plate 28 is inserted into the grooves 20, 22 from one side thereof. However, a plate may be conceived which is placed from above into the slot 16, wherein its length side is oriented toward the length side of the slot 16. Subsequently, the plate is turned about some 90° so that the sides thereof enter the grooves 20, 22. It should be understood that other than triangular groove shapes may be provided.

The pedicle screw 10a shown in Fig. 6 comprises a threaded shaft 12a and a head 14a having a lower side which is shaped similar to the head 14 of the pedicle screw shown in Figs. 1 and 2. The head alike includes a receiving slot 16a for inserting a distracting or compressing bar 18a. The walls of the slot 16a are provided with opposite ribs 17, 19 which are substantially located centrally with respect to the slot 16a. The head 14a has an upper

portion including an outer thread 40 ending at a shoulder 42. A cap nut 46 comprises an inner thread 44 which is screwed on the outer thread 40. The cap nut 46 includes a threaded portion provided in the front wall 48 to receive a fixing screw 50 having a hexagonal head 52 including an internal hexagonal configuration 54. At the side opposite the threaded portion 44 there is an axial flange 56 integrally formed to the front wall 48 accommodating the head 52 of the screw 50 when being screwed in.

In screwing the cap nut 46 onto the head 14a of the pedicle screw 10a the distracting or compressing bar 18a is initially fixed and can move in an axial direction as well as perpendicularly thereto. By fixing the screw 50, the bar 18a is then finally secured to the pedicle screw 10a. In the embodiment of Figs. 6 and 7 the final fixing may be performed by the nut 46 becoming seated on the bar as well as by means of the fixing screw 50.

It should be understood that lamina hooks, for example may be provided as anchoring means instead of the pedicle screws, which hooks are then provided with a head similar to that of the pedicle screws shown. It should be further understood that the shanks of the pedicles screws may be separate with respect to the heads which can be shaped to define ball-shaped recesses for receiving balls formed at the upper end of the screw shanks. This similarly applies for lamina hooks having a ball.

#### Claims

1. An apparatus for correcting a spinal column having damaged vertebrae comprising a fastener to be secured to adjacent vertebrae, said fastener including a shaft portion, preferably a pedicle screw, which fastener has a receiving slot to receive a distracting or compressing bar at its free end, and a first locking element including a threaded portion which may be secured onto the bar disposed in that receiving slot, characterized in that a second locking element (28,46) is provided which can be fixed to the free end of said fastener (10,10a) and which threadably receives said first locking element (26,50).
2. Apparatus of claim 1, wherein said second locking element (28) is shaped plate-like to be inserted in opposite grooves (20,22) which are provided in the walls of the receiving slot (16).
3. Apparatus of claim 2, wherein the grooves (20,22) are closed at one end thereof.

4. Apparatus of claim 2 or 3, wherein the grooves (20, 22) are sloped.
5. Apparatus of one of claims 2 to 4, wherein said second locking element (28) is received in said grooves (20,22) in a clamping manner. 5
6. Apparatus of one of claims 2 to 5, wherein said grooves (20,22) have a triangular cross-section, wherein one side thereof is defined by the groove wall. 10
7. Apparatus of claim 6, wherein the side of the groove wall facing away from the anchoring means (12) extends perpendicular with respect to the longitudinal axis of the slot (16). 15
8. Apparatus of claim 1, wherein the threaded portion in said second locking element (46) is formed in the front side (48) of a cap nut which is can be threaded onto an outer thread (40) of said fastener (10a) which outer thread is provided adjacent the receiving slot (16a). 20

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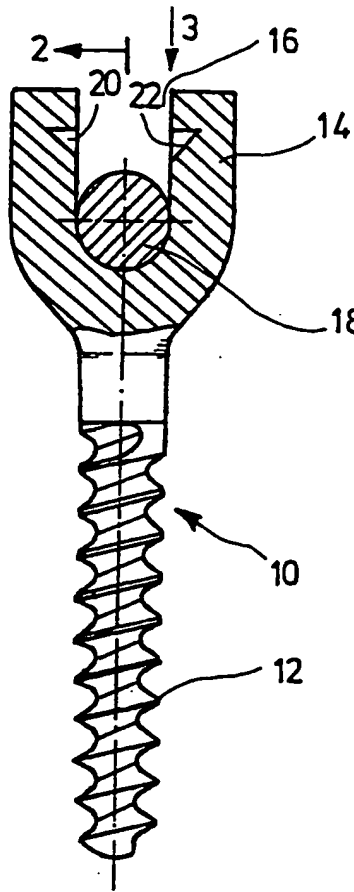


FIG. 1

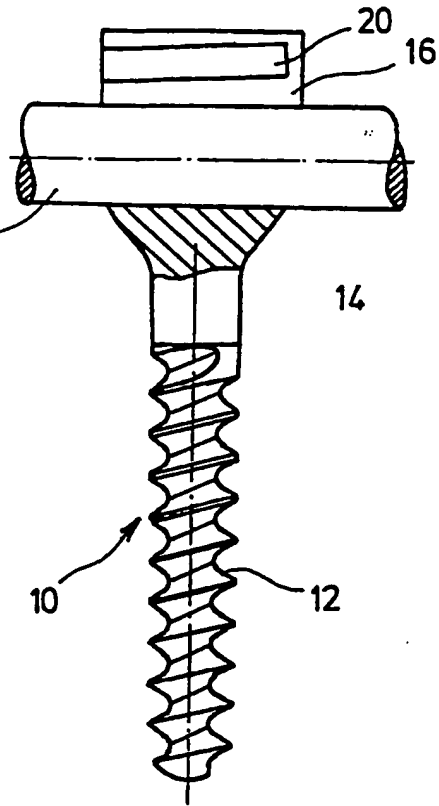


FIG. 2

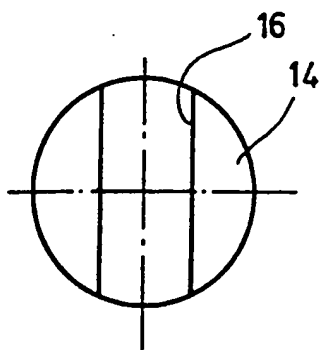


FIG. 3

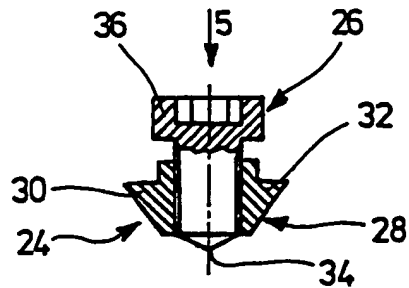


FIG. 4

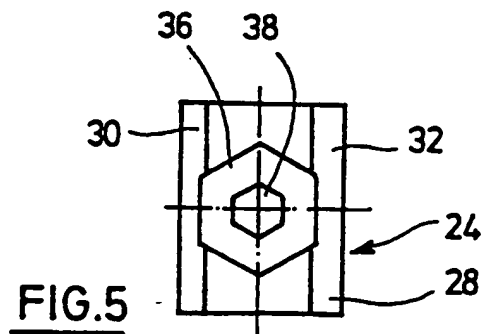


FIG. 5

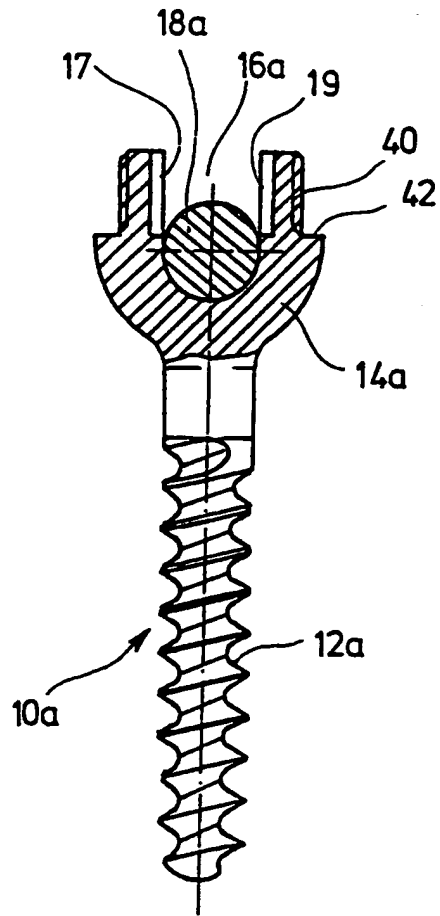


FIG. 6

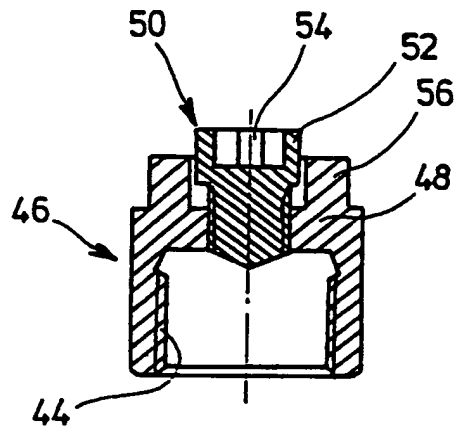


FIG. 7



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# EUROPEAN SEARCH REPORT

Application Number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 95100878.8
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 6)
X	<u>US - A - 5 257 993</u> (M.A. ASHER et al.) * Fig. 15-17, 20-22; column 7, line 66 - column 9, line 12 *	1, 8	A 61 B 17/56 A 61 B 17/70
Y	--	2	
A	--	5, 6	
X	<u>US - A - 4 887 596</u> (M. SHERMAN) * Totality *	1	
Y	--	2	
A	--	6	
Y	<u>DE - A - 4 107 480</u> (H. ULRICH) * Totality, especially column 3, lines 12-14; claim 3 *	2	
A	--	1, 6, 7	
X	<u>FR - A - 2 624 720</u> (S.F.M.O.) * Fig. 1-5; abstract; claims 1, 2, 4 *	1, 8	TECHNICAL FIELDS SEARCHED (Int. Cl. 6)  A 61 B
X	<u>US - A - 5 217 497</u> (S.M.H. MEHDIAN et al.) * Fig. 11, 12; abstract; column 5, lines 32-50 *	1	
A	----	8	
The present search report has been drawn up for all claims			
Place of search <b>WIEN</b>	Date of completion of the search <b>18-05-1995</b>	Examiner <b>LUDWIG</b>	
CATEGORY OF CITED DOCUMENTS X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document		T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons  A: member of the same patent family, corresponding document	